

Fiscal stimulus and the improvement of fiscal space by economic growth

A study of European countries with low economic growth

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Antti Sillanpää
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Department of Economics
Aalto University
School of Business

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| Author Antti Sillanpää | | |
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Abstract

This thesis examines what would be the impact of fiscal stimulus on the fiscal debt of GDP in the low economic growth conditions to conclude, whether the fiscal stimulus tightens or improves the government fiscal space. This is studied by comparing the change in the fiscal debt of GDP when the fiscal policy is used to stimulate the economy, with the case that the government does not stimulate. The increase in the economic growth that is achieved by the fiscal stimulus, which is a one per cent increase in the government spending of GDP, is measured by the fiscal multiplier. The fiscal multiplier is estimated in the period 2004Q1-2015Q2 using the estimation sample that consist of the European countries: France, Italy, Portugal, Spain, Slovenia and Finland. Also, it is examined what is the economic growth that is needed in the countries to achieve an improvement in the fiscal budget deficits from the year 2014 level, a one per cent fiscal surplus of GDP by the end of the year 2019. The differences between countries in the size of the fiscal budget deficits sets the countries in different positions in the capability to achieve the economic growth that also would lead to the targeted improvement in the fiscal budgets. The study is further used to assess, how the differences between the countries on the recovery in the economic growth have led to that the countries are in different positions in terms of what is a need for the fiscal policy to stimulate the economy.

Keywords the fiscal stimulus, the fiscal multiplier, the fiscal debt of GDP, the fiscal space, the fiscal budget balance, the real GDP growth, the general government

Tiivistelmä

Tutkimus tarkastelee fiskaalispoliittisen elvytyksen vaikutusta julkisen talouden velkaan suhteessa BKT:n alhaisen talouskasvun vallitessa, fiskaalispoliittisen elvytyksen joko tiukentaen tai parantaen julkisen talouden tilaa. Tätä tarkastellaan vertaamalla julkisen talouden velan kasvua tapaukseen, kun fiskaalispoliittinen elvytys toimenpide on toteutettu verrattuna siihen, että fiskaalispoliittista toimenpidettä ei toteuta. Fiskaaliskertoimella mitataan fiskaalispoliittisen elvytys toimenpiteen, joka on yhden prosentin lisäys julkisissa menoissa, aikaansaata talouskasvua. Fiskaaliskerroin estimoidaan periodilla 2004Q1-2015Q2 käyttäen sen estimointiin otosjoukkoa Euroopan maita: Ranska, Italia, Portugali, Espanja, Slovenia ja Suomi. Tutkimuksessa myös tarkastellaan mikä on vaadittu talouskasvu, jotta saavutettaisiin parannus näiden maiden julkisen talouden budjetti vajeissa vuoden 2014 tasosta vuoden 2019 loppuun mennessä. Budjettivajeen parannus on määritetty tarkastelussa yhden prosentin budjettilyijäämän saavuttamiseksi. Erot maiden välillä budjettivajeiden suuruuden osalta asettaa maat eri tilanteeseen, mahdollisuudessa saavuttaa talouskasvulla tavoitteen mukainen parannus julkisen talouden budjetissa. Myös tarkastelu osoittaa eroja maiden talouskasvussa, mikä johtaa siihen, että maat ovat eri asemassa, miten fiskaalispoliittista elvytystä tarvitaan parantamaan talouskasvua.

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1 Introduction

Maintaining sound fiscal positions is important to the Euro area countries as acknowledged by ECB. There are no longer national monetary and exchange rate policies to respond to country-specific negative economic shocks, thereby the fiscal policy is the main policy tool for the European countries to cushion such shocks. But the higher fiscal debt of GDP in some of the European countries has resulted in the concern, that the fiscal policy used to stimulate the economy does not lead to a recovery in the economic growth in the long-term.

The fiscal debt in this thesis study constitutes on the debt held by the central government, local government and social security funds. The annual GDP is the nominal gross domestic product in the country that measures the value of the total production at the current prices, which is created in the country within the year according to definition of the Eurostat.

When the European countries' fiscal space are studied in this thesis, it is witnessed that in Finland the level of the annual fiscal debt of GDP is 60 percentages, in Slovenia 81 percentages of GDP and in France 95 percentages of GDP in the year 2014. A considerably higher level of the annual fiscal debt of GDP is in Italy, Spain and Portugal. In Italy and Portugal the level of the annual fiscal debt of GDP is close to 130 percentages in both countries, and in Spain fiscal debt of GDP is 100 percentages. Also, the annual fiscal budget deficits have been high in those European countries: three percentages of GDP in Finland and Italy, and four percentages of GDP in France and five percentages of GDP in Slovenia in the year 2014. Considerably higher fiscal budget deficits over six percentages of GDP have existed in Portugal and Spain in that year.

There is concern that the fiscal stimulus does not lead to a sustainable recovery in the economic growth in the countries where the fiscal debt of GDP is already higher, because the fiscal stimulus would further tighten the government fiscal space. As the tightened fiscal space increases the interest costs of the further borrowing, which evidence is found by Aizenman et. al. (2013), the higher interest costs on the fiscal debt results in that the government becomes more restricted to further borrow, and thereby taxes are required to be increased. Because the increased taxing has a negative impact on the economic growth it follows that, the higher economic growth that is earlier achieved by the fiscal stimulus can no longer be sustained.

The study of the depressed economies is used to conclude, how the fiscal stimulus changes the government fiscal space in the European economies with low economic growth – either improving or tightening the fiscal space. It is studied by comparing the change in the fiscal debt of GDP, when the government stimulates with the case that the government does not stimulate the economy. The fiscal stimulus is in this study considered to be a one percentage increase in the government spending of GDP which is financed by borrowing. The yearly fiscal multipliers that measure the increase in the economic growth that is achieved

by the fiscal stimulus are estimated using the sample of the European countries in the period 2004Q1-2015Q2: France, Italy, Portugal, Spain, Slovenia and Finland.

It is further noted that the study of the depressed economy only relates to the European countries where economic growth has been witnessed to be low in the year 2014: Spain, Italy, Portugal, France and Finland. In Slovenia, economic growth has recovered in 2014 such largely that its economic growth can no longer be regarded to be low. According to the low economic growth conditions in the countries, it is presumed in the analysis that without the fiscal stimulus the annual economic growth rate is one per cent.

In accordance with the countries' fiscal budget deficits of GDP and tax ratios in the year 2014, it is examined how large an increase in the economic growth is required to obtain a one per cent fiscal surplus of GDP within five years. Based on the findings is discussed on the improvement in the fiscal budgets of countries to be achieved by the fiscal stimulus. The analysis further shows whether the economic growth has recovered until the year 2014 in the surveyed countries such largely that increase in the economic growth over time also leads to a one per cent fiscal surplus of GDP by the end of the year 2019.

The economic growth leads to a reduction in the fiscal budget deficit as it increases the tax revenues. In the analysis, it is presumed that the tax revenues of countries increase according to the countries' tax ratios by the increase in the level of the GDP. Thereby this study also shows how the different tax regimes between the countries regarding tax ratios result in differences in what would be the need for the higher economic growth.

The analysis of this study on the improvement of the fiscal budget balance by economic growth is motivated by the concern that the higher fiscal debt of GDP tightens the countries' fiscal space. This is reflected in the European Commission's guidance of the countries to control their fiscal budgets. According to the European Commission's Stability and Growth Pact (SGP) it is required that the annual fiscal budget deficit does not exceed three percentages of GDP. This budget rule aims to reduce the growth of the fiscal debt of GDP and thereby to avoid that countries' fiscal space further tightens, especially in those countries where the level of fiscal debt of GDP is higher.

In the literature section the earlier studies' empirical and theoretical findings are presented on how the fiscal stimulus impacts on the economic growth, and thereby it is discussed further whether the fiscal stimulus or the fiscal consolidation acts can be seen more advantageous in improving the government fiscal space. The fiscal consolidation acts constitute of the policy acts of the reduction in the government expenditures or increase in taxes with purpose to reduce the fiscal budget deficits.

The paper is organized as follows. Section 2 is presents the fiscal debt of GDP dynamics with fiscal multiplier for the purpose of the empirical study of this thesis. Section 3 is the literature review. The section 4 presents the yearly estimated fiscal multiplier values, and the methodology to estimate the fiscal multiplier. In section 5 are the empirical studies: the study of the depressed European economies, and the

study of the required economic growth to improve the fiscal budgetary balances, and section 6 concludes the study results. The appendices present empirical methodological details on how the fiscal multiplier is estimated, and the details on the fiscal debt of GDP dynamics.

2 Dynamics of fiscal debt of GDP with fiscal multiplier

In this section the fiscal deficits and the fiscal debt of GDP dynamics are presented for the purpose to empirically measure the effect of the fiscal stimulus on the fiscal debt of GDP. In research that examines the long-term dynamics of the fiscal debt of GDP, or that studies the sustainability gap of fiscal debt or the debt stabilization, it is reasonable to use the assumption that the economic growth is constant in the long term. But when studying the effect of the fiscal stimulus on the fiscal debt dynamics, it needs to be taken into account that also the stimulus changes the economic growth. The empirical yearly fiscal multiplier measures that the fiscal stimulus, which is a one per cent increase in the government spending of GDP, denoted as $\frac{\Delta G_0}{Y_0}$, increases the economic growth from the year 0 to $t=1, \dots, 5$. is

$$\mu_t = \frac{Y_t - Y_{t-1}}{Y_0} \quad (1)$$

It is assumed that the fiscal stimulus affects the annual base economic growth, which is annually one per cent, denoted as $\bar{g} = 1\%$. Hence, without the effect of fiscal stimulus on the economic growth, the real GDP increases by five per cent during five years. The fiscal stimulus increases the annual base economic growth \bar{g} according to the estimated values of yearly fiscal multipliers μ_t as shown in the eq.1 leading to the economic growth from the year 0 to $t=1, \dots, 5$, as $g_t = \frac{Y_t - Y_0}{Y_0}$.¹

I use the same approach as Delong and Summers (2012) measuring how the fiscal stimulus impacts on the change in the fiscal budget $\frac{\Delta D_t}{Y_0}$ assuming that the tax revenues increase proportionate by the level of the GDP according to the constant tax ratio τ . Thereby an increase in the tax revenues $\frac{\Delta T_t}{Y_0}$ is measured with the economic growth g_t for $t = 1, \dots, 5$, as

$$g_t \tau = \frac{\Delta T_t}{Y_0} \quad (2)$$

Using the eq.2 that shows the increase in the tax revenues, and presuming that the government expenditures are not changed in the further years, that is $G_t = G_0$, then the change in the fiscal budget deficits for the year $t=1, 2, 3, 4$ and 5, becomes

¹ To measure the increase in the economic growth from the base year $t=0$ to t taking into account that there is the stimulus effect on the base economic growth \bar{g} , the growth in the real GDP is obtained for the year $t=1, \dots, 5$, as $g_t = (1 + \bar{g})^t - 1 + \sum_{i=1}^t \mu_i$

$$\frac{\Delta D_t}{Y_0} = \frac{\Delta G_0}{Y_0} - \sum_{i=1}^t g_i \tau \quad (3)$$

Using the change in the fiscal budget deficits as shown in the eq.3, and denoting that the fiscal stimulus increases the initial level of the government fiscal budget deficit that is $\frac{D_0}{Y_0}$ by $\frac{\Delta G_0}{Y_0}$, the fiscal budget deficit is for time $t=1, \dots, 5$, as

$$\frac{D_t}{Y_0} = \frac{D_{t-1}}{Y_0} + \frac{\Delta D_t}{Y_0} \quad (4)$$

The impact of the fiscal stimulus on the fiscal debt of GDP is studied according to the fiscal debt of GDP dynamics, as

$$\frac{B_t}{Y_t} = \frac{B_0}{Y_0} \frac{(1+r)^t}{(1+g_t)} + \sum_{i=1}^t \frac{D_i}{Y_0} \frac{(1+r)^{t-i}}{(1+g_t)} \quad (5)$$

The fiscal debt of GDP dynamics as shown in the eq. 5 uses the fact that the economic growth is measured by g_t , so the real GDP for the year $t=1,2,3,4,5$ is obtained as $Y_t = Y_0(1 + g_t)$. The stimulus increases the economic growth, which also impacts on the tax revenues, and thereby to year t fiscal balance $\frac{D_t}{Y_0}$ as shown in the eq.5. The fiscal debt of GDP dynamics is measured by the assumption that the real interest rate is constant which is denoted as r and the initial level of the fiscal debt of GDP in the year $t=0$ is denoted as $\frac{B_0}{Y_0}$. In the appendix the fiscal debt of GDP dynamics is derived in more detail for the years $t=1, \dots, 5$ by the assumption of constant economic growth.

3 Literature review – The fiscal policy to improve economic growth and fiscal space

The literature section presents the empirical and theoretical findings on how the fiscal stimulus effects on economic growth. And based on those findings it is further discussed how the fiscal policy when used to stimulate the economy impacts on the government fiscal space. Also, another view to improve the fiscal space is introduced in the academic research, fiscal consolidation, which constitutes on the fiscal policy acts of cutting the government spending or increasing taxes.

The tightened fiscal space is found to be restrict how well the fiscal stimulus can lead to a sustainable economic growth in the long term, because the tightened fiscal space is found to increase the interest costs of the government further borrowing. Aizenman et. al. (2013) find evidence using a panel of OECD countries that a tighter fiscal space has increased the risk premiums on the government debt. In their study the fiscal space is measured by the ratio of the tax revenues to the fiscal debt. The authors found that the lowered ratio of tax revenues have on average resulted in higher risk premiums on the government bonds.

Similarly, Boussard et. al. (2012) argue that the money markets have reacted on the increased fiscal debt of GDP in some of the European countries, by tightening the lending conditions for the public sector. Rawdanowicz (2013) reasons that the high fiscal debt in the European countries limits the governments' capability to cushion negative economic shocks. Thereby considering the fiscal policy to stimulate the economy that is financed by the debt, it is of concern how high level of the fiscal debt of GDP the stimulus leads to in the later years.

The tightened fiscal space increases the interest costs of the government's further borrowing, and thereby reduces the capability of the government to raise the new loan without increasing taxing. Ricardian equivalence introduced by Ricardo (1820) in "Essay on the funding system" is an important theory, which shows that when a government finances its spending by borrowing it leads to the households to save a larger part of their income which reduces the effect of the stimulus. This is because the households foresee that the government increases taxes in the future since the government is required later on to pay back the borrowed fiscal debt. The households increase their saving to offset the negative impact of the increased taxes on their future net wealth. The Ricardian equivalence theory presumes that the households reduce their consumption such that it fully offsets the effect of the government spending that would otherwise increase the aggregate demand in the economy.

Gali et.al. (2007) show a reason why the debt financed fiscal stimulus does not necessarily increase the households' saving, even if households would behave as Ricardian equivalence theory presumes. They argue that households which are constrained to take credit use more on the extra income for consumption. Baum and Koester (2011) argue that households and firms are more credit constrained in a downturn, as banks eliminate credit lines or increase the risk premia on interest rates for loans.

The higher economic growth that is achieved by the fiscal stimulus leads to higher tax revenues and thereby over time reduces the fiscal debt of GDP. Thereby it is not necessary that the fiscal stimulus even if it at first increases the fiscal debt of GDP, it later on results in tightened fiscal space. Based on the earlier academic research findings on the values of the fiscal multipliers that are estimated in different economic cycles, evidence is found that the fiscal stimulus is more effective in the downturns than upturns (Baum and Koester, 2011; Auerbach et.al 2012; Sola, 2013). The fiscal multipliers estimated in the downturns range between 1.5-2.3, whereas in the upturns fiscal multipliers are estimated to be less than one.

By pointing out the mechanism how an increase in the government spending affects economic growth, can be shown for the reason the fiscal stimulus to increase economic growth more in the downturns than in the upturns. Langdana (2009) in his book presents that when the economy becomes supply constrained, there is less response by the supply of the economy to the increased aggregate demand. The more of the production potential of the economy is used, which is usually the case the higher is the economic growth, the less an increase in the government spending can stimulate economic growth even it increases the

aggregate demand. The theoretical reason that the stimulus increases economic growth less when the economy becomes more supply constrained can be also seen in the same sense that the public sector increased consumption or investments uses part of the resources, which otherwise can be used for the consumption or investments in the private sector.

Auerbach and Gorodnichenko (2012) present that when the economy has slack in the production capacity, an expansionary government spending does not necessarily crowd out resources from the private sector usage in the downturns. Langdana (2009) further reasons that the savings of households that are not used by the firms to the investments are idle funds in the economy. He presents that the government borrowing those idle funds from the households and further using them for its own consumption or investments increases the economic activity. It is further noted that the investments are lower in the downturns, as argued by Pollini (2011). He presents that the low confidence in the economy discourages the firms to invest, and thereby the government might be the advantage of making more investments, and borrow funds for that purpose from the households. The households are not necessarily directly the lenders to the government, but as the pension institutions, and also banks invest their funds to government bonds, the capital the public sector raises from the money market is savings of the households.

Delong and Summers (2012) reason that an economic hysteresis, that is the persistent decline in the potential output, can be prevented or at least reduced when the fiscal policy is used to stimulate the economy. Ball and Mankiw (2002) argue that the hysteresis effect in the labor markets arises, when the long persistent unemployment reduces working skills and motivation to search work. The decline in the number of workforce and productivity of the workforce leads to the lower production potential of the economy. Thereby a fiscal stimulus can also be used to prevent the severe recession which otherwise can last a long time because of decline in the potential output.

The reduction of the fiscal debt of GDP is also studied in terms of the fiscal consolidation that constitutes an increase in tax revenues or cutting the government expenditures. Alesina et.al. (2015) estimate the effects of fiscal consolidation in the study period 2009-2013. They have concluded in their study using their narrative data on the budget changes that fiscal consolidation acts have been conducted in the European countries. They note in their study that the fiscal consolidation acts might have slowed down the recovery in the economic growth, but they further note that this conclusion is not possible to empirically confirm in their study.

Eyraud and Weber (2013) have argued that it is challenging to reduce the fiscal debt of GDP by fiscal consolidation. They show with their intuitive fiscal debt dynamics model that the higher is the fiscal multiplier or tax ratio, the larger reduction in the government expenditures is required to reduce the fiscal debt of GDP. Also, Pollini (2010) argues that fiscal consolidation acts that lower the output growth might also worsen the confidence in the economy. While Batini et.al. (2012) using a large panel sample of the

OECD countries find evidence that a reduction in the government spending has reduced the overall price level. Both authors further conclude that the deflationary pressures on the fiscal consolidation reduce the capability of the government to reduce the fiscal debt since the real costs of servicing the fiscal debt increase.

The simultaneous fiscal consolidation acts conducted in many countries that belong to the same market regime lead to lower exports overall within the countries as argued by Eyraud and Weber (2013). This is because in the countries that conduct the fiscal consolidation acts the demand for imported goods reduces. The demand for the imports declines when the fiscal consolidation acts lowers the aggregate demand in the economy. Thereby the simultaneously coordinated fiscal consolidation acts in the European countries do not necessary lead to a large reduction in the fiscal debt of GDP in those countries that take the effort to reduce the fiscal debt.

The empirical and theoretical findings of academic research show that the fiscal consolidation efforts involve the risk that economic growth declines, as cutting the government spending or increasing taxes both have a negative impact on the economic growth. The increased government spending can be a boost for the economy that faces a downturn, as shown by the empirical and theoretical findings. Thereby it is not necessary that the government debt financed fiscal stimulus tightens the fiscal space in the downturns.

4 The yearly fiscal multipliers for the depressed economy - estimation by the country sample: Spain, Italy, France, Portugal, Slovenia and Finland

The yearly fiscal multipliers are estimated in the study period 2004Q1-2015Q2 using the estimation sample of the European countries Italy, Spain, Portugal, France, Slovenia and Finland, where the economic growth has been slow since the year 2008. Blanchard and Perrotti (2002) have shown that the effect of fiscal stimulus acts on the economic growth can be estimated using the impulse responses. I use that approach to estimate the fiscal multiplier for the depressed economies.

The values of the yearly estimated fiscal multipliers of the government consumption are shown in the table 1. The results show that a one per cent increase in the government consumption has on average increased the economic growth in the sample countries during the five years by 0,65 per cent, that is the sum of the values of yearly fiscal multipliers.

| Year | 1 | 2 | 3 | 4 | 5 |
|---|----------|----------|----------|----------|----------|
| Government consumption, μ_t | 0,25 % | 0,17 % | 0,10 % | 0,07 % | 0,055 % |

Tabel.1 The yearly fiscal multipliers of the government consumption, estimated as one per cent increase in the government consumption.

The government consumption has been in average twenty percentages of the real GDP in the surveyed countries, so a one percentage increase in the government consumption of GDP corresponds to a five per cent increase in the government consumption.² Thereby a one percentage increase in the government consumption of GDP increases the economic growth during the five years by 3,3 per cent according to the estimated yearly fiscal multipliers.

However, this assumes that the increased government consumption does not induce larger crowding out effects. The benchmark in some degree for this estimated value of the fiscal multiplier is from Burriel et.al. (2009) who estimated the fiscal multiplier for Euro-area. It is estimated that a one percentage increase in the government spending of GDP increases the economic growth during five years by 2,6 per cent. In that study the government spending constitutes of the sum of government consumption and government investments and the fiscal multiplier is estimated in the period 1981Q1-2007Q4.

Government consumption is used to estimate the fiscal multiplier rather than government expenditures. Estimating the fiscal multiplier using the government expenditures is less reliable, because there is likely to be cyclical in the government expenditures. As the government expenditures change strongly by the output growth, it complicates the estimation of the change in the output resulting from the change in the government expenditures. It can not be distinguished if the expenditures have changed because of the change in the level of real GDP, and thereby estimate how the change in the expenditures by the adjustment made in the fiscal policy would change the real GDP.

The panel vector auto regression is used to estimate the residuals for the tax revenues, government spending and output. Those residuals are further used to identify the fiscal shocks by estimating the structure of the shock dynamics, and based on the estimated shock dynamics the impulse response analysis is used to estimate the effect of government spending shock to output growth. Hamilton (1994) presents the impulse response analysis for vector autoregression models, which is also applied for panel vector auto regression models. The derivation of the impulse responses of the variables are shown in the appendix using the moving average $MA(\infty)$ representation to panel vector auto regression model, and the structural shocks that are identified by the shock dynamics.

I follow the Blanchard and Perrotti (2002) identification scheme to estimate the structural shocks $u_{t,i} = (u_{t,i}^T, u_{t,i}^G, u_{t,i}^Y)$ of the government spending, tax revenues and output. The structural shocks identification is presented in the appendix, as also there is presented the estimation results of the shock structure by OLS in the table 9. The identification of the contemporaneous shock structure is the following

²As the government consumption of GDP is $G/Y = 20\%$, it results in that a one percentage increase in the government consumption of GDP, that is $\Delta G/Y = 1\%$ corresponds to a five per cent increase in the government consumption $\Delta G/G = 5\%$. This result is seen from the following identity $\Delta G/G * G/Y = \Delta G/Y$.

$$\begin{aligned}\varepsilon_t^T &= a_1 \varepsilon_t^Y + u_t^T \\ \varepsilon_t^G &= b_2 u_t^T + u_t^G \\ \varepsilon_t^Y &= c_1 u_t^T + c_2 \varepsilon_t^G + u_t^Y\end{aligned}$$

The cyclicity in the residuals of tax revenues ε_t^T results in that there is simultaneous change in the residuals of tax revenues and residuals of output. Thereby before estimating the parameters c_1 and c_2 which capture the structural shock dynamics for the residual of the output equation ε_t^Y , it is required to calibrate the parameter a_1 that measures the tax revenues elasticity to output.

The calibration of the elasticity of the tax revenues to output is conducted by following the approach of Blanchard and Perrotti (2002).³ Following that approach, I use the estimates of Girourd and Andre (2005) estimates on the different tax item elasticities to output in the European countries, and further use the same tax item shares of the total taxes based on the 27 European countries in the year 2010. The shares of the tax items on the total taxes are obtained using the taxing data published by the European Commission. The elasticity of tax revenues to output that is the parameter a_1 is calibrated as 0,9. The calibration is more detail presented in the appendix and the results are also there shown in the table 11. When the parameters c_1 and c_2 are estimated, it is found that the coefficient that captures the contemporaneous response of the output to the government spending shock, which is the parameter c_2 , becomes more significant when the elasticity of tax revenues is calibrated to be slightly lower value than what is calibrated using the method.

The PVAR model that is shown in the eq.6 for each country $i=1, \dots, 6$. is used to estimate the residuals $\hat{\varepsilon}_{t,i} = (\hat{\varepsilon}_{t,i}^T, \hat{\varepsilon}_{t,i}^G, \hat{\varepsilon}_{t,i}^Y)$ in the equations of government spending, tax revenues and output. The PVAR model is estimated by the least squares dummy variables regression, LSDV. The same estimation methodology for PVAR model to estimate the fiscal variables dynamics is used by Ilzetzi et.al. (2013). They use the LSDV regression to estimate the panel vector autoregression to study how the impact of the fiscal shocks on the economic growth depends on the country characteristics. The tax revenues, government spending and output are included in the levels in the logarithmic form in the PVAR model, as a vector $Y_{t,i} = (t_{t,i}, g_{t,i}, y_{t,i})$. The PVAR model for the country i is presented, as

$$Y_{t,i} = C_{0,i} + B_1 Y_{t-1,i} + B_2 Y_{t-2,i} + \varepsilon_{t,i} \quad (6)$$

The residuals in the PVAR model are assumed to be distributed as i.i.d $\varepsilon_t \sim N(0, \Sigma)$ with zero mean and time invariant covariance matrix Σ . The country specific characteristics that are not changing in time, fixed effects, are captured by the country specific constants $C_{0,i}$ that are 3x1 vectors for each $i=1, \dots, 6$. countries.

³ By denoting the elasticities of the tax bases to output as $\gamma(i)$ and the elasticity of each type of tax item to its tax base as $\eta(i)$, then the elasticity of tax revenues to output is, as shown by Blanchard and Perrotti (2002),

$$a_1 = \sum_{t=i}^n \eta(i) \gamma(i) \frac{\tau(i)}{\tau}$$

The time trend t is not included in PVAR model as an exogenous variable, because it is found to have negligible small coefficient value in regressions of the taxes and government spending, and not to be significant at 5 % level in the equation for the output. The least squares dummy variable estimation approach is applicable for the panel vector auto regression model when the data consists of a balanced panel meaning that there are no missing observations on the sample of countries in the estimation time horizon.

The impulse responses of the output y_{t+h} to the government spending shock u_t^G at time t are used to estimate the fiscal multiplier. The fiscal multiplier on the government spending is measured from the impulse responses for the quarterly period $q=1,2,\dots,4$, as $\mu_{t+q} = \sum_{j=1}^q \frac{\partial y_{t+j}}{\partial u_t^G}$. From that sum of four quarter multipliers the annual economic growth relative to the base year is measured in the end of each year $h=1,\dots,5$, as $\mu_{t+h} = \frac{\Delta Y_{t+h}}{Y_0}$. The impulse responses measure the change in the variable relative to the time of the shock $t=0$.

The total revenues of general government, the general government consumption and the real GDP by country in the period 2004Q1-2015Q2 are obtained from the Eurostat. The total government revenues also include other items than tax revenues, as interests on the government financial investments, and thereby does not totally represent the revenues on the tax items. A one year moving average is taken of the total revenues of general government for eliminating seasonality in the time-series. The GDP price deflator is used to deflate the nominal tax revenues and government consumption to real values using the reference year 2010.

The stability test based on the eigenvalues that are obtained on the companion form of PVAR model shows that the PVAR model is stable as all the eigenvalues are less than one in absolute value. The results on the stability test are shown in the appendix in the table 8. For estimating the impulse responses, it is important for the stability condition of the PVAR model to hold. It ensures that the effect of a shock that is a one percent increase in the government spending of GDP on the output growth decays over time to zero.

The results on the estimation of PVAR model using LSDV are shown in the appendix in the table 8. But as it is of interest only to estimate the residuals of the tax revenues, government spending and output using the panel vector auto regression, the significance of the estimated coefficient values in those variables regressions are not commented on. The information criteria test results for Schwarz (1978), BIC and Akaike (1974), AIC are shown in the table 10 in the appendix, as also therein are presented these model specification test formulas. Based on the information criteria of BIC two lags are selected to estimate the PVAR model. AIC criteria would choose a one order higher lag model to estimate the PVAR model. The criteria for choosing the lag order for both test is to choose the lag order in the regressions that minimizes the value of the information criteria. This leads to minimize the forecast errors in the PVAR regressions. Choosing the appropriate number of lags in the PVAR model is important to capture the dynamics of the

tax revenues, government spending and output, as it affects the estimate of the residuals of those variables, which are used to estimate the dynamics of the fiscal and output shocks.

The autocorrelation graphs of the variables show that there is autocorrelation prevailing in the fourth lags of the variables' residuals (see, appendix figure 3). But by regressing the residuals against its own four lags using OLS it is confirmed that most of the lagged residuals for the variables are not significant supporting that there is no serious autocorrelation problem prevailing. Also, the graphical inference on the residuals shows that the LSDV estimation of the PVAR model captures the dynamics of variables, as the residuals are randomly fluctuating around the zero means (see, appendix figure 4). As there is no serious autocorrelation in the residuals, it supports to proceed to estimate the fiscal and output shocks dynamics using the residuals estimated with the PVAR model as shown in the eq.6.

5 An empirical study on the effect of fiscal stimulus on the fiscal space in the European countries

The study of the depressed economy reflects what would be the impact of the fiscal stimulus on the fiscal debt of GDP in the European countries where the economic growth has been low. The effect of the fiscal stimulus on the economic growth is estimated by the yearly fiscal multipliers, and thereby the impact of fiscal stimulus on the fiscal debt of GDP is studied. The values of the yearly fiscal multipliers are estimated using the sample of the countries: Spain, Italy, Portugal, Slovenia, France and Finland. Thereby those values of fiscal multipliers show, how on average the fiscal stimulus increases the economic growth in those countries. The estimated yearly fiscal multipliers μ_t , are shown in the section 4 in the table 1, and those are further scaled to consider a one percentage increase in the government consumption of GDP as presented earlier in that section.

In the study of the depressed economy it is considered that there is low economic growth, as it is assumed that without the fiscal stimulus the annual economic growth is one per cent. The fiscal stimulus increases this annual economic growth during the surveyed period of five years according to the estimated fiscal multipliers. The low annual economic growth that is considered in the analysis represents the low economic growth conditions in the year 2014. In the table 6 in the appendix are shown the annual growth rates of the real GDP. It is witnessed that in Spain and Portugal the annual real GDP growth is close to one per cent in both countries in the year 2014, whereas in France the annual growth rate of the real GDP is almost zero. In Finland and Italy the annual real GDP growth has been negative in the year 2014. In Slovenia economic growth has recovered in the year 2014 such largely that its economic growth can no longer be regarded to be low.

It is also surveyed what would be the required increase in the economic growth to be achieved by the fiscal stimulus such that it leads to improvement in the fiscal budgets in the countries. This is concluded in accordance of the fiscal budget deficits of GDP and tax ratios in the countries in the year 2014. It is studied how large GDP growth from the year 2014 is required to be such that the fiscal deficit of GDP turns into a one per cent fiscal surplus during the five years.

5.1 An analysis on the effect of fiscal stimulus on the fiscal debt of GDP: study of the depressed economy

According to the fiscal debt of GDP dynamics presented in the section two and further shown here in the eq.7, the change in the fiscal debt of GDP is studied when the fiscal stimulus is made, and in the case the government has not stimulated the economy. The fiscal debt of GDP in the year $t = 1, \dots, 5$ becomes

$$\frac{B_t}{Y_t} = \frac{B_0}{Y_0} \frac{(1+r)^t}{(1+g_t)} + \sum_{i=1}^t \frac{D_i}{Y_0} \frac{(1+r)^{t-i}}{(1+g_t)} \quad (7)$$

The growth in the real GDP from year 0 to $t=1, \dots, 5$. is denoted as g_t . When the government stimulates the economy, it is taken into account that the fiscal stimulus increases the annual base economic growth that is \bar{g} according to the yearly fiscal multipliers μ_t . The countries tax ratios are shown in the appendix in the table 7. In the study, a tax ratio is used τ that is 45 percentage which is in the range of the tax ratios in the surveyed countries.

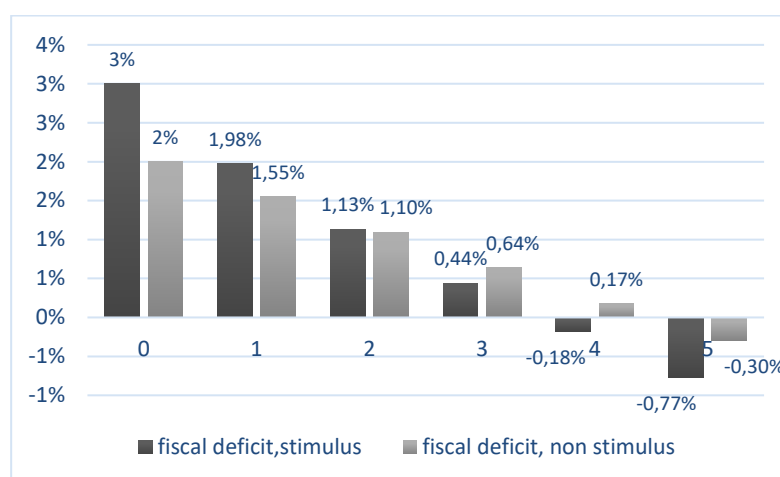
It is assumed that the annual economic growth is one per cent when the government does not stimulate the economy. It is considered in the analysis that there is no large increase in the interest costs of the fiscal debt. Thereby when there is no stimulation of the economy, it is presumed that the relative difference between the interest on the government debt and the economic growth denoted as $r - \bar{g}$ stays as half percentages during the study period.

It is assumed that the government stimulates the economy by a one percentage increase in the government consumption of the GDP, which incurs the same size increase in the deficit of GDP, denoted as $\Delta D_0/Y_0 = 1\%$. The results in the table 2 show that the initial fiscal budget deficit that is three per cent of GDP results in that the fiscal stimulus increases the fiscal debt by 2,2 percentages of GDP during the five years. The economic growth when the fiscal policy is used to stimulate the economy is in that period 8,4 percent. When the economy is not stimulated, it is found that the fiscal debt of GDP increases more with stimulation of the economy. The fiscal debt of GDP increases by 4,8 percentages when the government does not stimulate the economy, and the economic growth is 5,1 percentages.

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|------|--------|--------|--------|---------|---------|
| The deficit of GDP, stimulus | 3 % | 1,94 % | 1,09 % | 0,42 % | -0,17 % | -0,71 % |
| The fiscal debt of GDP, stimulus | 65 % | 66,5 % | 67,3 % | 67,7 % | 67,7 % | 67,2 % |
| economic growth $\Delta Y(t)/Y(0)$ | | 2,27 % | 1,88 % | 1,54 % | 1,38 % | 1,31 % |
| Fiscal stimulus impact on the growth, μ_t | | 1,27 % | 0,87 % | 0,52 % | 0,35 % | 0,27 % |
| Fiscal debt of GDP, no stimulus | 65 % | 66,9 % | 68,3 % | 69,2 % | 69,7 % | 69,8 % |

Table 2. The impact of fiscal stimulus on the fiscal debt of GDP, and non-stimulus impact on the fiscal debt of GDP.

In the figure 1 are shown the government fiscal deficits in these two cases when the government has used the fiscal stimulus and when it has not stimulated the economy. It is seen that a higher economic growth that is achieved by the fiscal stimulus results in a larger fiscal surplus in the end of the surveyed period in the fifth year. This is even though the stimulus results in a one percentage higher fiscal deficit of GDP in the year 0.



The figure 1. The fiscal budget deficits during the five-year period, in the case of fiscal stimulus of government and non-stimulus.

The 10-yr. government bond real interest rates in the countries during the year beginning of 2015 are shown in the appendix in the table 6. The low interest rate on the government borrowing in the countries supports that the stimulus increasing the real GDP and thereby resulting in higher tax revenues which offsets the increased costs on the fiscal debt that are induced by financing the stimulus by the debt.

The higher tax ratio in some of the countries as in Finland, Italy and France than considered in this study leads to that in those countries, there is larger increase in tax revenues achieved by the increase in the economic growth. Thereby the fiscal stimulus by the debt financing would result in that the fiscal debt of GDP increases less in those surveyed countries than what is estimated in this study.

The study results show evidence that in the surveyed European countries the increase in the government spending stimulates the economy such largely that according to the estimated values of fiscal multipliers the fiscal debt of GDP increases less when the fiscal stimulus is made than in the case without the stimulation. This is even though the stimulus leads to that there is initially a one per cent higher fiscal deficit

of GDP. It is further noted that this study only shows what is the effect of the fiscal stimulus on the economic growth on average in the surveyed European countries, as the estimate of the fiscal stimulus effect on the economic growth is based on the panel sample of the countries.

It is further looked at how large fiscal surplus of GDP is required for the fiscal debt of GDP to reduce by five percentages within the five years. It is further considered that the annual real interest rate r is 0,5 percentages higher than the annual economic growth g . The measurement of the target fiscal balance that is required to achieve the certain percentage reduction of the fiscal debt of GDP until the certain number of years T is presented by Escolano (2010). The approach is used to measure the annual level of a fiscal surplus that is denoted as d^* to achieve a five-percentage reduction in the fiscal debt of GDP within the five years, as

$$d^* = \frac{\frac{1+r}{1+g}-1}{\left(\frac{1+r}{1+g}\right)^{-T}-1} \left[\left(\frac{1+r}{1+g}\right)^{-T} (b_0 - 0,05) - b_0 \right]$$

In this analysis three different levels of the fiscal debt are considered, denoted as b_0 which are 65, 90 and 130 per cent of GDP. The fiscal surpluses of GDP that are required to be maintained during the five years such that a five-percentage reduction in the fiscal debt of GDP is achieved are shown in the in the table 3. It is concluded that even when there is initially a considerably high fiscal debt of GDP there is not required to be a considerably high fiscal surplus of GDP.

| | | | |
|------------------------------|--------|--------|--------|
| Fiscal debt of GDP | 65 % | 90 % | 130 % |
| Fiscal surplus in GDP | 1,31 % | 1,43 % | 1,63 % |

Table 3. The fiscal surpluses in GDP that result in the five-percentage reduction in the fiscal debt of GDP within the five years.

A one percentage annual fiscal surplus of GDP reduces the fiscal debt of GDP approximately by one percentage in a year. This assumes that the annual real GDP growth is almost at the same level as the annual real interest rate on the government debt, that is $r_t \approx g_t$.⁴ In the next section, it is studied how large actually should be the increase in the annual GDP growth in the countries such that fiscal budget deficits turn into a one percentage surplus of GDP. This fiscal budgetary surplus results in that over time the fiscal debt of GDP reduces and thereby the government fiscal space improves.

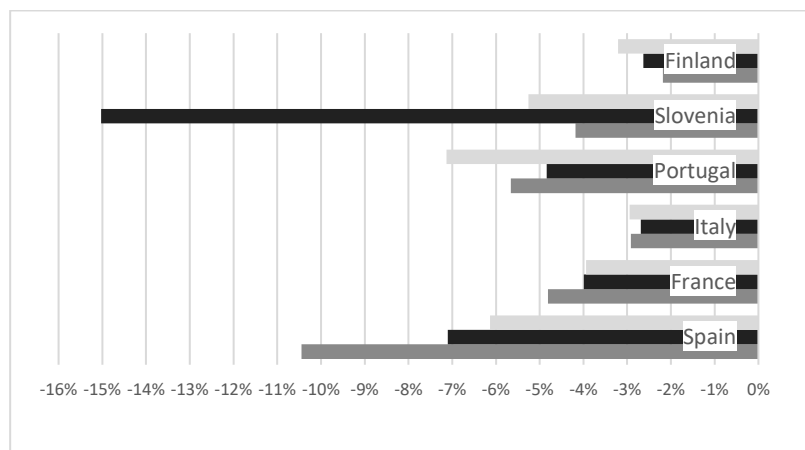
⁴ Annual fiscal debt of GDP dynamics, as $\frac{B_t}{Y_t} = \frac{B_{t-1}}{Y_{t-1}} \frac{(1+r_t)}{1+g_t} + d_t$, where $D_t = G_t - T_t$ is the fiscal deficit in a year.

5.2 The analysis on the required economic growth to improve the fiscal budget deficits in the surveyed European countries: 2015-2019

According to the fiscal budgetary deficits and the countries' tax ratios in the year 2014, it is studied what is the annual real GDP growth such that a fiscal budgetary surplus that is one percentage of GDP is achieved in the countries: Spain, Portugal, Italy, Slovenia and Finland. In the appendix in the table 7 are shown the growth rates of GDP, denoted as g , which are required in the countries for their fiscal budget deficits to turn into a one per cent fiscal surplus of GDP. These growth rates are further used to conclude what is the required annual real GDP growth in the country to achieve the targeted level of the fiscal surplus of GDP during the five years. This counterfactual analysis shows how largely the government fiscal stimulus is required to increase the economic growth such that fiscal budgets in the countries improve.

In the analysis, it is presumed that the government expenditures are kept at the same level as has been initially in the year 2014. Therefore, as the tax revenues increase by an increase in the level of GDP, the annual GDP growth reduces the fiscal deficit over time. In the analysis, it is assumed that tax revenues increase proportionately to the level of the GDP according to the countries tax ratios. This is the same as the assumption of a constant unit elasticity of the tax revenues to output.

In the figure 2 are shown the fiscal budget balances of GDP in the countries from the year 2012 to 2014. It is seen that the fiscal budget deficits have been considerably high 6,1 percentages of GDP in Spain, and 7,1 percentages in Portugal in the year 2014. In Slovenia, the fiscal budget deficit of GDP has been lower than in these two countries, as the fiscal budget deficit has been 5,3 percentages in the country in the year 2014.



The figure 2. The fiscal budget balances of GDP in the period 2012-2014;
source: Eurostat

In Finland, Italy and France the fiscal budget deficits have been lower than in the other surveyed countries. In Finland and Italy, the fiscal budget deficits have been close to three percentages and one per cent higher in France in the year 2014. The fiscal budget deficit of GDP is measured as the difference of the ratio of

government expenditures to GDP and the tax ratio. The tax ratios of the countries and the level of the fiscal budget deficits in the year 2014 are shown in the table 4.

In the table 4 are shown the annual growth rates of real GDP that are required to be sustained in the countries during the period 2015-2019 to achieve a one per cent fiscal surplus of GDP in the end of the year 2019. It is seen that a considerably higher real GDP growth is required in Spain, Portugal and Slovenia than in Finland, France and Italy. In Spain and Portugal the considerably higher fiscal deficits of GDP and also lower tax ratios than in those other countries result in that a considerably higher real GDP growth is required to be achieved during the surveyed five year period.

| | G/Y, 2014 | T/Y, 2014 | Fiscal deficit of GDP, 2014 | G/Y, 2019 | T/Y, 2019 | the annual real GDP growth, 2015-2019 |
|-----------------|-----------|-----------|--------------------------------|-----------|--------------|---|
| Spain | 44,7 % | 38,6 % | 6,1 % | 37,6 % | 38,6 % | 3,5 % |
| France | 57,5 % | 53,6 % | 3,9 % | 52,6 % | 53,6 % | 1,8 % |
| Italy | 51,1 % | 48,2 % | 2,9 % | 47,2 % | 48,2 % | 1,6 % |
| Portugal | 51,7 % | 44,5 % | 7,1 % | 43,5 % | 44,5 % | 3,5 % |
| Slovenia | 50,1 % | 44,8 % | 5,3 % | 44,5 % | 44,8 % | 2,7 % |
| Finland | 58,1 % | 54,9 % | 3,2 % | 53,9 % | 54,9 % | 1,5 % |

Table 4. The fiscal balance in the year 2014. the government expenditures in GDP (G/Y), the government tax ratio (T/Y) and nominal GDP (Y) in the year 2014; source Eurostat.

These annual required growth rates of real GDP that must be maintained from the year 2015 to the end of the year 2019 are compared to the annual growth rates of real GDP in the countries in the year 2014. This shows what is the required increase in the growth rate of real GDP in the year 2015 such that when this growth is maintained over five years, a one percentage fiscal surplus of GDP is achieved in the end of the year 2019. The table 5 shows the required increase in the annual real GDP growth in the surveyed countries, as also the annual real GDP growth during the period 2012-2014.

| The yearly GDP growth | 2012 | 2013 | 2014 | The required increase in the real GDP growth, 2015 |
|-----------------------|--------|--------|--------|---|
| Spain | -2,6 % | -1,7 % | 1,35 % | 2,15 % |
| France | 0,2 % | 0,7 % | 0,2 % | 1,6 % |
| Italy | -2,9 % | -1,8 % | -0,4 % | 2,0 % |
| Portugal | -4,0 % | -1,1 % | 0,9 % | 2,6 % |
| Slovenia | -2,6 % | -1,0 % | 2,85 % | -0,15 % |
| Finland | -1,4 % | -1,1 % | -0,4 % | 1,9 % |

Table 5. The yearly increase in the economic growth required to be achieved by the fiscal stimulus such that a one percentage fiscal surplus in GDP is obtained in the five-year period, from the beginning of the year 2015 to the end of 2019.

It is found that in Spain as well as in Portugal, even though the economic growth has slightly recovered in both countries in the year 2014, it is still required that there is a large increase in the annual real GDP growth. It is required that the annual real GDP growth increases by 2,15 percentages in Spain and 2,6 percentages in Portugal from the annual real GDP growth in the year 2014.

A negative real GDP growth in Finland and Italy in the year 2014 results in that there is required to be a large increase in the annual real GDP growth. It is required that the annual real GDP growth increases by 1,9 percentages in Finland and 2,0 percentages in Italy. The higher annual real GDP growth in France than in those two other countries, and also a low level in the fiscal deficit of GDP leads to that a lower increase is needed in the annual growth rate of real GDP. In Slovenia, the economic growth has recovered in the year 2014, such that there is no need for a further increase in the annual real GDP growth to achieve a one percentage fiscal surplus of GDP. In Slovenia, the annual real GDP growth has been 2,85 per cent in the year 2014, whereas the annual real GDP growth of 2,7 per cent is required to achieve a one per cent fiscal surplus of GDP within the surveyed five-year period.

The fiscal stimulus improving the economic growth and thereby increasing the government tax revenues is the way the fiscal stimulus can also lead to the improvement in the fiscal budget balances. According to the above results the possibility to achieve the improvement in the fiscal budgets using the fiscal policy to stimulate the economy in the surveyed countries is discussed on next.

5.2.1 The fiscal stimulus to improve the fiscal budget deficits

In Spain, the fiscal budget deficit has been six percentages of GDP and in Portugal seven percentages of GDP, whereas the fiscal budget deficits have been considerably lower in Finland and Italy, three percentages of GDP in the year 2014. In France the fiscal budget deficit has been a slightly higher in the year 2014, as it is has been four percentages of GDP.

In the analysis, it is found that in Finland, Italy and France a considerably lower annual real GDP growth that is close to one and half percent is required to achieve a one per cent fiscal surplus of GDP from the year 2015 until the end of the year 2019. In Spain and Portugal a higher annual real GDP growth of three and half percent is required. Thereby it is concluded that when the fiscal policy is used to stimulate the economy the required growth rate of the annual real GDP is more probably achieved in Finland, Italy and France than in Spain and Portugal.

This conclusion is based on the empirical evidence that the fiscal policy is found to increase the economic growth more in the downturns than in the upturns, which finding is based on the studies where the fiscal multipliers are estimated in the different cycles (Baum and Koester, 2011; Auerbach et.al.,2012; Sola, 2013). Also, Langdana (2009) presents that the economy becomes more supply constrained when the economic growth is already higher, which shows that the fiscal policy stimulates the economy more in those countries with lower economic growth. This argument is based on the reasoning that the higher is the economic growth the more of the production potential of the economy is used. Therefore, the aggregate supply increases less even when the increased government spending creates higher demand in the economy. According to the above argument, the fiscal stimulus becomes more constrained to further increase the

economic growth. It is concluded, that as in Finland and Italy there has been negative annual real GDP growth, it is possible to achieve a larger increase in the annual real GDP growth than in Spain and Portugal. In Spain and Portugal such a high annual real GDP growth is required during the five years to be maintained, that it is hard to achieve. The higher reduction in the fiscal budget deficits is achieved either by increasing taxing or by cutting the government spending. However, those fiscal policy acts can slow down the economic growth and thereby reduce the recovery in the economic growth. Alesina et.al. (2015) find empirical evidence that increase in taxes and reduction in the government spending, have negative impact on the economic growth. In their study the response of output growth on the change in the government expenditures and taxes are estimated based on fiscal budgetary changes during the period 2009-2013. The study results are based on a sample of the European countries including also some of the OECD countries. Similarly, the earlier studies in which the fiscal multipliers are estimated on the government consumption find that the values of the multipliers are positive, when the impact of increased government consumption on the economic growth is estimated. Thereby those studies show evidence that a reduction in the government spending has a negative impact on the economic growth (Blanchard and Perrotti, 2002; Burriel et. al., 2009; Baum and Koester 2011; Auerbach et.al., 2012).

The negative growth rates of real GDP in Finland and Italy in the year 2014 leads to that there is need for a large increase in the GDP growth, such that the required rates of annual real GDP growth are achieved to obtain a one per cent fiscal surplus of GDP. Thereby in Spain, Portugal, Italy and Finland there are no large differences in the size of the increase that is needed in the annual real GDP growth. A large annual real GDP growth to be maintained during the five years in Spain and Portugal compared to Finland and Italy makes it harder to achieve the required reduction in the fiscal deficits to achieve the targeted improvement in the fiscal balance during the five years from the year beginning of 2015. This is even though the annual real GDP growth in Spain and Portugal has increased to close to one percent in the year 2014, which indicates that the economic growth in those countries has slightly recovered.

6 Conclusion

It is a concern that the fiscal stimulus does not lead to a sustainable recovery in the economic growth in the European countries where the fiscal debt of GDP is higher. The tightened fiscal space might reduce the recovery in economic growth, because the tightened fiscal space increases the government's further borrowing costs, for which evidence is found by Aizenman et. al. (2013). Similarly, Boussard et. al. (2012) presents that the money markets have reacted on the increased fiscal debt of GDP leading to pressure on the fiscal space of a number of European countries. It is further reasoned that the governments need to increase taxes when the costs for the further borrowing increases, which slows down the recovery in the economic growth. Thereby in the European countries where the fiscal debt of GDP is higher, when the

fiscal stimulus increases the fiscal debt of GDP further, it is a concern that the fiscal stimulus does not lead to a sustainable recovery in the economic growth.

In this thesis, it is studied whether the fiscal stimulus can be seen increasing the economic growth such largely that the fiscal stimulus does not tighten further the government fiscal space in the European countries France, Italy, Portugal, Spain, Slovenia and Finland in the year 2014. This is assessed by the study of the depressed economy, comparing the change in the fiscal debt of GDP when the government has stimulated the economy to the case it has not stimulated. In Slovenia the economic growth has been such high in the year 2014 that its economic growth can be no longer regarded to be low, and thereby the study of the depressed economy less represent the fiscal debt of GDP dynamics in the country by the economic growth.

The sample of the European countries is used to estimate the values of yearly fiscal multipliers that represent the average increase in the annual economic growth in the sample of the countries when the economy is stimulated. To the extent, as these fiscal multipliers are used to examine, how the fiscal stimulus impacts on the fiscal debt of GDP, the study on the depressed economy reflects on how the fiscal stimulus affects the fiscal debt of GDP in those European countries. In the analysis, it is presumed that the government does not increase the expenditures in the further periods. Thereby the higher economic growth reduces the fiscal deficits over time because the economic growth leads to increase in the tax revenues according to tax ratio.

The fiscal stimulus is in the study considered to be an increase in the government consumption that is one per cent of GDP. In the study, it is found that using the fiscal stimulus such a large increase in the economic growth is achieved, that when there is one percentage higher fiscal deficit of GDP, the fiscal debt of GDP increases less than in the case the economy is not stimulated. Thereby the result also shows, that as the fiscal stimulus reduces the growth in the fiscal debt of GDP, there is less need to be concerned that the fiscal stimulus would tighten the government fiscal space more than in the case it is not stimulated the economy.

The initially low economic growth that is one per cent, leads to that the fiscal debt of GDP increases further when the government fiscal deficit is three percentages of GDP. Thereby this result shows that the fiscal debt of GDP to be reduced during the five-year period requires a larger increase in the economic growth than what is estimated to be achieved by the fiscal stimulus according to the fiscal multipliers. In the analysis, a low interest rate on the government debt is presumed, as found to be prevailing in the surveyed European countries during the year 2014. This supports that the larger fiscal debt taking does not lead to the considerably higher accumulation in the interest on the fiscal debt.

It is further noted that as there are differences in the tax ratios between the countries, the fiscal stimulus increasing the economic growth results in differences in how the fiscal deficits reduce in the countries, and thereby changes the fiscal debt of GDP. The estimated values of yearly fiscal multipliers only show the average increase in the economic growth in the surveyed European countries when the government

consumption is increased. Thereby the stimulus effect on the economic growth differs from what is estimated with the values of fiscal multipliers.

It is also studied, what is the required annual growth rate of real GDP in France, Italy, Portugal, Spain, Slovenia and Finland such that the annual fiscal budget deficit turns to one per cent surplus of GDP. The analysis is based on the level of the tax ratios of the countries in the year 2014. The fiscal budget surpluses are targeted to be achieved during the five years, from the year beginning of 2015 until the end of the year 2019. It is presumed that the government does not increase further its expenditures. It is found that there is required to be a large increase in the annual real GDP growth in most of the surveyed countries.

The study shows that the differences between the countries in their level of the fiscal budget deficits and tax ratios in the year 2014 lead to differences in how large annual real GDP growth is required to achieve a one per cent fiscal surplus of GDP during the surveyed five years. Also, it is found that as there are differences between the countries in the recovery in the economic growth, the countries are in a different position in what is the required increase in economic growth to be achieved by the fiscal stimulus. The higher economic growth that results in a fiscal budget surplus overtime leads to a reduction in the fiscal debt of GDP, and thereby also improvement in the government's fiscal space.

In Finland and Italy the annual real GDP growth was negative in the year 2014, and in France only a few percentage points higher than zero. Therefore, in those countries it is more likely that the fiscal policy when used to stimulate the economy can be used to achieve higher economic growth, and thereby also the improvement in the fiscal budgets. It is found that in these countries an annual real GDP growth of close to one and half per cent is enough to be maintained during the five years to achieve a one per cent fiscal surplus of GDP. In Portugal and Spain the economic growth has recovered in the year 2014, the annual real GDP growth is close to one per cent in the both countries. But as a high annual real GDP growth of 3,5 per cent is required to be maintained during the five years, it is less likely that the fiscal stimulus can lead to such a high annual economic growth that a one per cent fiscal surplus of GDP during the five years is achieved. It is further concluded to require to cutting the government expenditures or increase in taxes.

Higher economic growth which can also be maintained in the longer term is needed for the fiscal budgets to improve when neither cuts are made in the government expenses nor taxes raised. This discussion on the fiscal stimulus increasing the economic growth and thereby leading to improvement in the fiscal budget deficits is based on the empirical and theoretical findings of earlier studies. Those show that fiscal policy is less capable to increase the economic growth further, the higher already is the economic growth. It is also presented based on the earlier empirical findings that the fiscal consolidation acts that are cuts in the government spending or increases in taxes do not necessarily lead to large reductions in the government fiscal budget deficits.

The fiscal multipliers are one possibility to empirically estimate what is the impact of the increased government spending on the change in the fiscal debt of GDP, and thereby to assess the effect of the fiscal stimulus on the fiscal space. In the future research, a similar approach as in this study using the estimated yearly fiscal multiplier values can be used to measure the impact of the fiscal stimulus on fiscal debt of GDP. Estimating the fiscal multipliers by country and using the fiscal data of those countries' tax ratio, interest rate on the government debt and the base annual economic growth, the economic growth that prevails without the government stimulus, is the way to study in detail the impact of the stimulus on the fiscal debt of GDP by country. The stimulus effect of the fiscal policy is complicated to estimate, because also other factors than the changed fiscal policy influence the economic growth the changes in the real GDP. This study, relying on the panel vector auto regression methodology to estimate the fiscal multiplier based on the fiscal shocks, also suffers of that complication.

Appendix

The dynamics of fiscal debt of GDP

$D_t = G_t - T_t$ is the fiscal deficit

$\frac{B_t}{Y_t^N}$ is the level of the fiscal debt in the nominal GDP

g the growth rate of real GDP

$\frac{P_t}{P_{t-1}} = 1 + \pi_t$, where π_t is the overall price inflation, CPI

The fiscal debt B_t for the next period becomes, as

$$B_t = B_{t-1}(1 + i_t) + G_t - T_t \quad (1)$$

By dividing the above equation of the fiscal debt with the nominal GDP Y_t^N , the fiscal debt of GDP is obtained as

$$\frac{B_t}{Y_t^N} = \frac{B_{t-1}}{Y_t^N} (1 + i_t) + \frac{G_t - T_t}{Y_t^N} \quad (2)$$

Assume further that the nominal interest rate on the government debt i is constant as also the output growth g . Then according to the eq.1 the fiscal debt for period $t=0,1,\dots,3$, when B_0 is the initial level of the fiscal debt that is not zero, becomes as

$$\begin{aligned} B_1 &= B_0(1 + i) + D_1 \\ B_2 &= B_1(1 + i) + D_2 = B_0(1 + i)^2 + D_1(1 + i) + D_2 \\ B_3 &= B_0(1 + i)^3 + D_1(1 + i)^2 + D_2(1 + i) + D_3 \end{aligned}$$

By recursively solving the fiscal debt for the period $t=T$ results in the following fiscal debt dynamics

$$B_T = B_0(1 + i)^T + \sum_{i=1}^T D_i(1 + i)^{T-i} \quad (3)$$

By dividing the above equation of the fiscal debt with the nominal output Y_T^N , the fiscal debt of GDP is obtained as

$$\frac{B_T}{Y_T^N} = \frac{B_0}{Y_T^N} (1 + i)^T + \sum_{k=1}^T \frac{D_k}{Y_T^N} (1 + i)^{T-k} \quad (3)$$

Using the result that the real interest rate on the government debt is $1 + r_t = (1 + i_t)/(1 + \pi_t)$, and the nominal GDP in the period t is $Y_t^N = Y_t(1 + \pi_t)$, since the nominal GDP is the real GDP Y_t multiplied by the increase in inflation π_t . Using these two results and denoting the initial level of output as Y_0 , the fiscal debt of GDP dynamics in the equation 3 becomes, as

$$\frac{B_T}{Y_T^N} = \frac{B_0}{Y_0} \frac{(1+r)^T}{(1+g)^T} + \sum_{k=1}^T \frac{D_k}{Y_0} \frac{(1+r)^{T-k}}{(1+g)^T} \quad (4)$$

The above fiscal debt of GDP dynamics in the eq.4 use the following result on the constant economic growth: $Y_t = (1 + g)^t Y_0$. In the equation (4) the dynamics of the fiscal debt of GDP from the yearly fiscal deficits of GDP is the term

$$\sum_{k=1}^T \frac{D_k}{Y_0} \frac{(1+r)^{T-k}}{(1+g)^T} \quad (5)$$

| | The government debt of GDP | The Real GDP growth | The real interest rate | The inflation |
|-----------------|-------------------------------|------------------------|---------------------------|---------------|
| Spain | 100,4 % | 1,36 % | 1,60 % | 0,76 % |
| France | 95,3 % | 0,17 % | 0,72 % | 0,57 % |
| Italy | 131,9 % | -0,38 % | 1,65 % | 0,88 % |
| Portugal | 130,6 % | 0,91 % | 2,29 % | 1,74 % |
| Slovenia | 80,9 % | 2,85 % | 1,47 % | 0,67 % |
| Finland | 60,2 % | -0,40 % | 0,58 % | 1,61 % |

Table 6. The annual GDP growth rates and annual inflation in the year 2014; The tax ratio is measured by the general government revenues in the year 2014; The government debt of GDP is measured by the annual average debt of general government in the year 2014; source: Eurostat, The average interest rates on 10-year government bonds in the period 2015Q1-2015Q2; source ECB.

| | G/Y(t), 2014 | T/Y(t), 2014 | Fiscal deficit, 2014 | 1+g | G/Y(t) | T/Y(t) | Fiscal surplus of GDP | the real GDP growth, g |
|-----------------|-----------------|-----------------|----------------------------|-------|--------|--------|-----------------------------|------------------------|
| Spain | 44,7 % | 38,6 % | 6,1 % | 1,19 | 37,6% | 38,6 % | 1,0 % | 19,0 % |
| France | 57,5 % | 53,6 % | 3,9 % | 1,094 | 52,6 % | 53,6 % | 1,0 % | 9,4 % |
| Italy | 51,1 % | 48,2 % | 2,9 % | 1,084 | 47,2 % | 48,2 % | 1,0 % | 8,4 % |
| Portugal | 51,7 % | 44,5 % | 7,1 % | 1,187 | 43,5 % | 44,5 % | 1,0 % | 18,7 % |
| Slovenia | 50,1 % | 44,8 % | 5,3 % | 1,143 | 43,8 % | 44,8 % | 1,0 % | 14,3 % |
| Finland | 58,1 % | 54,9 % | 3,2 % | 1,078 | 53,9 % | 54,9 % | 1,0 % | 7,8 % |

Table 7. The real GDP growth g required for the fiscal deficit from the year 2015 turn into a one percentage budget surplus of GDP. It is abbreviated the government expenditures in GDP (G/Y), the government tax ratio (T/Y); the government expenditures, the tax revenues and nominal GDP of countries in the year 2014 are from Eurostat.

The required economic growth g to obtain a one per cent fiscal surplus of GDP:

$$\frac{G_t - T_t}{Y_t} = \frac{G_0 - \tau Y_0(1 + g)}{Y_0(1 + g)} = \frac{G_0/Y_0}{1 + g} - \tau = 1\%$$

, where $\frac{G_0}{Y_0}$ is the ratio of the government expenditures to the level of the GDP in the year 2014 and τ is tax ratio.

Estimation results on Panel VAR model by least squares dummy variable regression, LSDV

| | T | G | Y |
|-------------|-------------------|-------------------|-------------------|
| I.1T | 1,077 (0,061) | -0,181 (0,086) | -0,060 (0,049) |
| I.1G | -0,043 (0,043) | 0,730 (0,061) | 0,019 (0,034) |
| I.1Y | 0,460 (0,074) | 0,187 (0,104) | 1,467 (0,059) |
| I.2T | -0,127 (0,060) | 0,139 (0,084) | 0,046 (0,047) |
| I.2G | 0,029 (0,041) | 0,172 (0,058) | -0,019 (0,033) |
| I.2Y | -0,422 (0,075) | -0,042 (0,106) | -0,525 (0,060) |
| d.1 | 0,211 | -0,255 | 0,755 |
| d.2 | 0,172 | -0,242 | 0,643 |
| d.3 | 0,227 | -0,224 | 0,764 |

| | | | |
|--|-------|--------|-------|
| d.4 | 0,287 | -0,239 | 0,933 |
| d.5 | 0,252 | -0,266 | 0,883 |
| d.6 | 0,272 | -0,264 | 0,915 |
| Eigenvalues: 0,959; 0,886; 0,861; 0,566; 0,210; 0,208 | | | |

Table 8. Estimation results of PVAR model using LSDV, estimation period 2004Q1-2015Q2 Panel estimation sample of the countries: Spain, France, Italy, Portugal, Slovenia and Finland. In the table tax revenues is abbreviated as T, government expenditures as G and output as Y.

| The Estimation of structural shock dynamics by OLS | | | | |
|---|----------|-----------|---------|-------|
| $u_t^T = \varepsilon_t^T - a_1 \varepsilon_t^Y$, when $a_1 = 0,9$ | | | | |
| ε_t^Y | Coef. | Std.Err. | t-value | P> t |
| c_1 | -0,30663 | 0,04215 | -7,27 | 0,000 |
| c_2 | 0,02916 | 0,0316452 | 0,92 | 0,358 |
| ε_t^G | Coef. | Std.Err. | t-value | P> t |
| b_2 | -0,26378 | 0,07873 | -3,35 | 0,001 |
| $u_t^T = \varepsilon_t^T - a_1 \varepsilon_t^Y$, when $a_1 = 0,97$ | | | | |
| ε_t^Y | Coef. | Std.Err. | t-value | P> t |
| c_1 | -0,33209 | 0,04031 | -8,24 | 0,000 |
| c_2 | 0,02364 | 0,03096 | 0,76 | 0,446 |
| ε_t^G | Coef. | Std.Err. | t-value | P> t |
| b_2 | -0,26086 | 0,07691 | -3,39 | 0,001 |

Table 9. The estimation results of the structural shock dynamics: the shocks of tax revenue, government spending and output.

The PVAR model lag-selection test

$$\text{AIC} \quad \ln|\hat{\Sigma}_{n \times n}| + \frac{2pK^2}{Tn}$$

$$\text{BIC} \quad \ln|\hat{\Sigma}_{n \times n}| + \frac{2\ln(Tn)}{Tn} pK^2$$

, where T=46 is length of the time series, K=3 is the number of variables, n=6 number of the countries and p is the number of lags used in the PVAR model equations.

| lag-order | AIC | BIC |
|-----------|---------|---------|
| 1 | -27.147 | -26.845 |
| 2 | -27.499 | -26.896 |
| 3 | -27.589 | -26.685 |
| 4 | -27.612 | -26.407 |

Table 10. The information criteria values for PVAR model, the lag order two minimizes BIC and four lags minimizes AIC.

PVAR(p) model in the companion form and stability test

PVAR(p) model in the reduced form, where $C_{0,i}$ is 3x1 vector of constants is shown as

$$Y_{t,i} = C_{0,i} + A_1 Y_{t-1,i} + A_2 Y_{t-2,i} + \dots + A_p Y_{t-p,i} + \varepsilon_{t,i}$$

The PVAR model with K variables and lag order p can be represented in the companion form by defining the matrix **A** that is KpxKp dimensional coefficient matrix of the above PVAR model, as follows

$$\mathbf{A} = \begin{bmatrix} A_1 & A_2 & \cdot & \cdot & \cdot & A_{p-1} & A_p \\ I_K & 0 & \cdot & \cdot & \cdot & 0 & 0 \\ 0 & I_K & & & & 0 & 0 \\ \cdot & & \cdot & & & \cdot & \cdot \\ \cdot & & & \cdot & & \cdot & \cdot \\ \cdot & & & & \cdot & \cdot & \cdot \\ 0 & \cdot & \cdot & \cdot & \cdot & I_K & 0 \end{bmatrix} \text{ and } \mathbf{U}_t = \begin{bmatrix} \varepsilon_{t,i} \\ 0 \\ 0 \\ \cdot \\ \cdot \\ \cdot \\ 0 \end{bmatrix} \quad \mathbf{Y}_t = \begin{bmatrix} Y_t \\ Y_{t-1} \\ Y_{t-2} \\ \cdot \\ \cdot \\ \cdot \\ Y_{t-p+1} \end{bmatrix} \quad \mathbf{C} = \begin{bmatrix} C_{0,i} \\ 0 \\ 0 \\ \cdot \\ \cdot \\ \cdot \\ 0 \end{bmatrix}$$

, then companion form of PVAR model is presented as $\mathbf{Y}_t = \mathbf{C} + \mathbf{A}\mathbf{Y}_{t-1} + \mathbf{U}_t$

Because the matrix \mathbf{A} is the square matrix, the eigenvalues of PVAR(p) can be calculated from \mathbf{A} to test the stability of PVAR(p) model

The stableness of the PVAR model is inferred using the stability test based on the following characteristic equation (Lüthkepol 2005, p.15)

$$\det(\mathbf{I} - \mathbf{A}\lambda) \neq 0 \text{ for } |\lambda| \leq 1$$

The PVAR model is stable if the all eigenvalues λ that are calculated as the determinant of matrix $\det(\mathbf{I} - \mathbf{A}\lambda)$ are inside the unit circle.

Infinite moving average $\mathbf{MA}(\infty)$ representation to structural panel vector autoregression model, SPVAR(p) and impulse responses

The stableness of the PVAR model allows inverting the PVAR model to $\mathbf{MA}(\infty)$ representation. The PVAR model is here presented in the companion form using the matrix \mathbf{A} . Then $\mathbf{MA}(\infty)$ representation to PVAR(p) can be shown by recursively solving backwards the PVAR(p) model, in the following way

$$\begin{aligned} Y_t &= C_0 + \mathbf{A}Y_{t-1} + \varepsilon_t \\ &= C_0 + \mathbf{A}(C_0 + \mathbf{A}Y_{t-2} + \varepsilon_{t-1}) + \varepsilon_t \\ &= C_0 + \mathbf{A}C_0 + \mathbf{A}^2Y_{t-2} + \mathbf{A}\varepsilon_{t-1} + \varepsilon_t \\ &= C_0 + \mathbf{A}C_0 + \mathbf{A}^2(C_0 + \mathbf{A}Y_{t-3} + \varepsilon_{t-2}) + \mathbf{A}\varepsilon_{t-1} + \varepsilon_t \\ &= C_0 + \mathbf{A}C_0 + \mathbf{A}^2C_0 + \mathbf{A}^3Y_{t-3} + \mathbf{A}^2\varepsilon_{t-2} + \mathbf{A}\varepsilon_{t-1} + \varepsilon_t \\ &\vdots \\ &= (\mathbf{I}_K + \mathbf{A} + \mathbf{A}^2 + \dots + \mathbf{A}^j)C_0 + \mathbf{A}^{j+1}Y_{t-j} + \sum_{k=0}^j \mathbf{A}^k \varepsilon_{t-k} \end{aligned}$$

According to Lüthkepol (2005, p.14) if \mathbf{A} has modulus less than 1, then the following results hold

$$\lim_{j \rightarrow \infty} (\mathbf{I}_K + \mathbf{A} + \mathbf{A}^2 + \dots + \mathbf{A}^j)C_0 \rightarrow (\mathbf{I}_K - \mathbf{A})C_0, \text{ and } \lim_{j \rightarrow \infty} \mathbf{A}^{j+1} \rightarrow \mathbf{0}$$

, which result in an infinite $\mathbf{MA}(\infty)$ representation to PVAR(p) model

$$Y_t = \mu + \sum_{k=0}^{\infty} \mathbf{A}^k \varepsilon_{t-k}$$

, where constant $\mu = (\mathbf{I}_K - \mathbf{A})C_0$ is according to above shown result as presented by Lüthkepol (2005).

By noting that the PVAR model error terms ε_t can be represented using the structural errors u_t as $\varepsilon_t = Pu_t$, where $P = \mathbf{A}^{-1}B$, it results in the equivalent representation to AB-model identification structure $\mathbf{A}\varepsilon_t = Bu_t$. Then $\mathbf{MA}(\infty)$ representation to SPVAR(p), where in this study case $p=2$, becomes represented according to the following formula

$$Y_t = \mu^* + \sum_{k=0}^{\infty} \mathbf{A}^k Pu_{t-k}$$

, where A is the coefficient matrix of the PVAR model in companion form and $A^0 = I$

Consider that a shock in the period $u_t \neq 0$, but there are no shocks before and after period t , then any period $h \geq t$ forecast for Y_{t+h} is obtained, as

$$\begin{aligned} Y_t &= \mu^* + A^0 P u_t \\ Y_{t+1} &= \mu^* + A^1 P u_t \\ &\vdots \\ Y_{t+h} &= \mu^* + A^h P u_t \end{aligned}$$

As constant term μ^* is not affected by the shock – the all exogenous terms can be suppressed from $MA(\infty)$ representation to Y_t in the impulse response analysis.

From the above representation one derives the impulse response matrix, as

$$IRF_{t+h} = \frac{\partial Y_{t+h}}{\partial u_t^G} = A^h P$$

The Identification of tax revenue, government spending and output shocks and the estimation of the dynamics of shock structure

As the residuals $\hat{\varepsilon}_t$ estimated using the PVAR model are mutually correlated, they can not be used to interpret the exogenous shock effect from one variable to another, as presented by Lüthkepol (2005, p.57-58). According to Lüthkepol (2005, p.58) by defining structural errors $A\varepsilon_t = Bu_t$ and by requiring also structural error covariance matrix $E(u_t u_t') = D$ to be a diagonal matrix, the decomposition of the original covariance matrix in PVAR model results in the following identification scheme of the structural shocks

$$\begin{aligned} \Sigma_t &= E(\varepsilon_t \varepsilon_t') = A^{-1} E(u_t u_t') A^{-1'} = A^{-1} D A^{-1'} = A^{-1} D^{\frac{1}{2}} D^{\frac{1}{2}} A^{-1'} \\ &= A^{-1} B B' A^{-1'} = P P' \end{aligned}$$

Blanchard and Perrotti (2002) have introduced the identification scheme to estimate the structural shocks of the government spending, tax revenues and output which I follow to estimate the structural shock dynamics. The structural shocks (u_t^T, u_t^G, u_t^Y) on the fiscal variables and output are identified of the variables error terms ε_t , that are the estimated as residuals from PVAR model shown in the eq.1. The identification of the shocks on tax revenues, government spending and output is presented as follows

$$\begin{aligned} \varepsilon_t^T &= a_1 \varepsilon_t^Y + a_2 u_t^G + u_t^T \\ \varepsilon_t^G &= b_1 \varepsilon_t^Y + b_2 u_t^T + u_t^G \\ \varepsilon_t^Y &= c_1 \varepsilon_t^T + \varepsilon_t^G c_2 + u_t^Y \end{aligned}$$

The residuals of tax revenues and government spending involves the cyclical component that is the residual of output ε_t^Y , which induces the adjustment to output change. The parameters a_1 and b_1 capture that cyclical adjustment in the tax revenues and government spending. Thereby non-cyclical tax revenues u_t^T and government spending can be represented as follows

$$\begin{aligned} u_t^T &= \varepsilon_t^T - a_1 \varepsilon_t^Y \\ u_t^G &= \varepsilon_t^G - b_1 \varepsilon_t^Y \end{aligned}$$

As the final consumption expenditures is used instead of total government expenditures, there is no cyclical fluctuation in the government spending (, or at least no strong cyclicity) leading to the parameter $b_1=0$. I assume that the tax revenues are not contemporaneously responding to government spending shocks, so the contemporaneous responses to these shocks

is identified, as $a_2 = 0$ and $b_2 \neq 0$. These same restrictions are imposed by the Blanchard and Perrotti (2002) to identify the dynamics of structural shocks, which results in the following identification scheme

$$\varepsilon_t^T = a_1 \varepsilon_t^Y + u_t^T \quad (2)$$

$$\varepsilon_t^G = b_2 u_t^T + u_t^G \quad (3)$$

$$\varepsilon_t^Y = c_1 \varepsilon_t^T + c_2 \varepsilon_t^G + u_t^Y \quad (4)$$

The above system can be casted to AB-model by defining $A\varepsilon_t = Bu_t$, then PVAR regression equations for the country $i=1, \dots, 5$. on tax revenues, government consumption and output becomes represented as the SPVAR shown in the eq.5.

$$Y_{t,i} = A^{-1}C_{0,i} + A^{-1}B_1Y_{t-1,i} + A^{-1}B_2Y_{t-2,i} + A^{-1}Bu_{t,i} \quad (5)$$

, and then covariance matrix has the following decomposition using the structural shocks identification scheme

$$\Sigma = A^{-1}BB'A^{-1'}$$

The identified structural shock dynamics shown as the system of the equations 2,3 and 4 can not be estimated directly equation by equation using the OLS, because the simultaneous causality in the tax revenues and output lead to biased estimate on the parameter a_1 in the eq.2. This is because of the residual of tax revenues ε_t^T includes the cyclical component. The cyclical component in the residuals of tax revenues results in that there is simultaneous change in the residuals of tax revenues and residuals of output. Thereby before estimating the shock structure that is the parameters b_2, c_1, c_2 , the parameter a_1 that measures the tax elasticity to output is calibrated.

The estimation of elasticity of tax revenues to output, the parameter a_1

Blanchard and Perrotti (2002) have introduced the idea to calibrate the elasticity of taxes to output using the elasticities of different type of tax items to their tax bases, and further using the estimated elasticities of the tax bases to real GDP by weighting each elasticity of the tax item its share of the total tax revenues. This is formally presented as by denoting the elasticities of the tax bases to output as $\gamma(i)$ and the elasticity of each type of tax item to its tax base as $\eta(i)$, then elasticity of taxes to output is, as

$$a_1 = \sum_{i=1}^n \eta(i) \gamma(i) \frac{\tau(i)}{\tau}$$

, where $\tau(i)/\tau$ is the share of the tax item i on the total tax revenues that is τ .

Following the Blanchard and Perrotti (2002) approach to calibrate the tax elasticity to output that is the parameter a_1 , I use Girourd and Andre (2005) estimates on the tax elasticities to output in the different tax items that are on average for the 28 European countries.

Their estimate on the elasticity of the personal income taxes to output is used as the elasticity to direct taxes and the elasticity of social contributions to output. They have noted that the elasticity of indirect taxes to output is close to one which value I assign to be the elasticity of the indirect taxes to output. The share of the tax items on the total taxes is measured based on the total taxes of the 28 European countries in the year 2010. This data on the tax items is obtained as taxing data from the European Commission. In the table 11 below is shown the calibration of the elasticity of tax revenues to output.

| | The share of tax revenues | The tax items elasticity to output | The tax items elasticity to output*tax share | The calibration of tax elasticity to output |
|-------------------------------|------------------------------|--|---|--|
| Taxes on labour income | 0,331 | 1,58 | 0,52 | |
| Indirect taxes: | 0,368 | 1,00 | 0,37 | |
| Social contributions: | 0,138 | 0,57 | 0,08 | |
| Total tax revenues | 0,837 | | 0,97 | 0,9 |

Table 11. The elasticity of the total tax revenue to output, and the tax items elasticities to output according to the study of Girourd and Andre (2005).

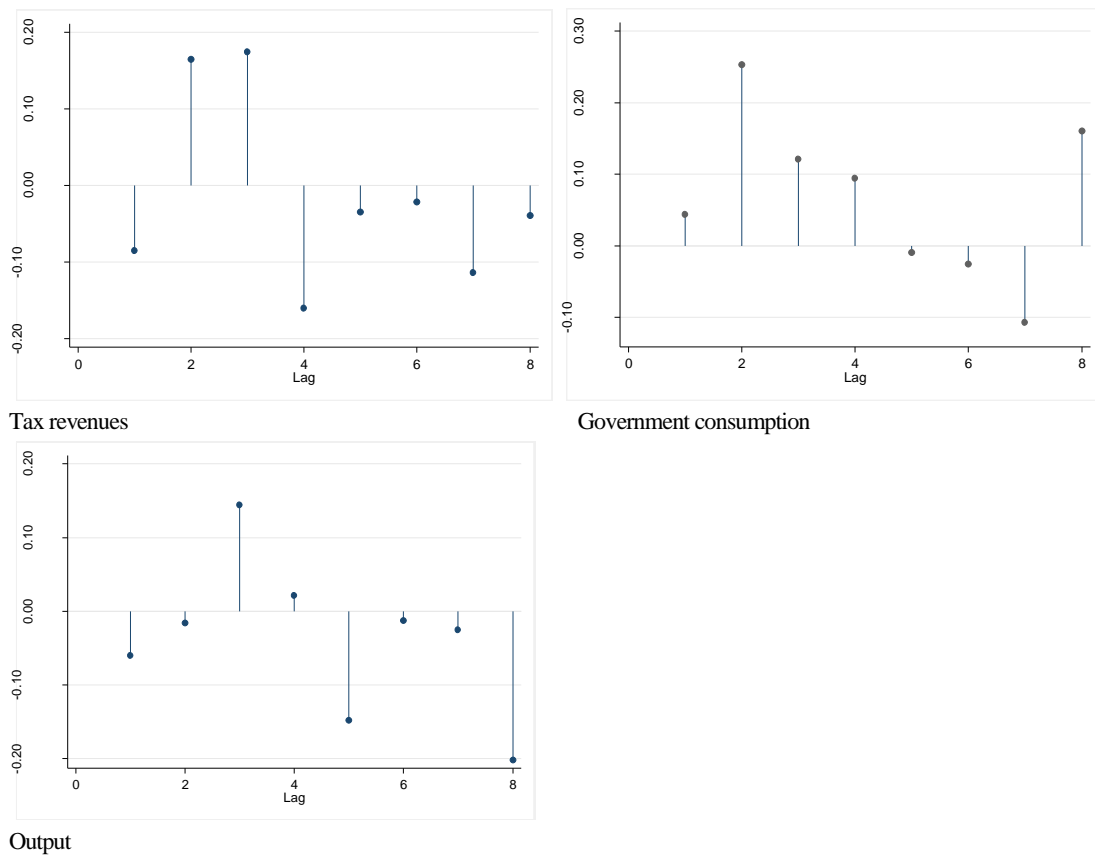
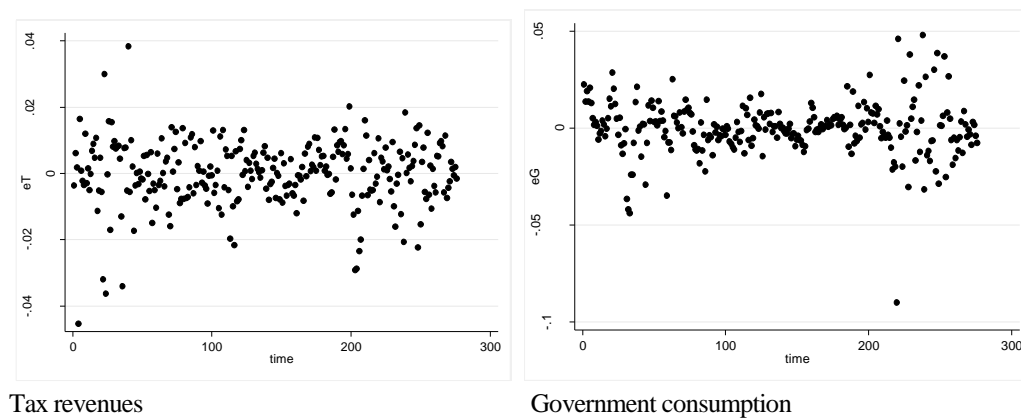
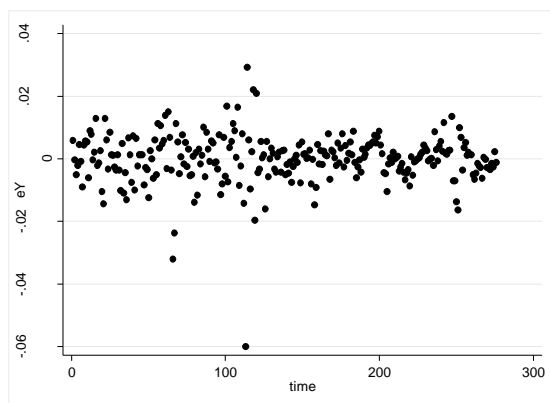


Figure 3. Autocorrelations of residuals of tax revenues, government consumption and output





Output

The figure 4. The residuals of tax revenues, government consumption and output

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Data and online sources

Data on tax revenues, government consumption and output:

<http://ec.europa.eu/eurostat/data/database>:European commission > Eurostat > Database > Economy and Finance.
Real GDP and nominal GDP: > National accounts (ESA 2010) > GDP and main components. SA, the quarterly frequency

Final consumption expenditure of General government:

National accounts (ESA 2010) > GDP and main components. SA, the quarterly frequency

Tax revenues of general government:

Government finance statistics (ESA 2010) > Non-financial accounts for general government. NSA, the quarterly frequency

Total General government expenditures:

Government finance statistics (ESA 2010) > Non-financial accounts for general government. NSA, the annual frequency

Fiscal debt of General government:

Government finance statistics (EDP and ESA 2010) > Government deficit and debt > Government deficit/surplus, debt and associated data > Government consolidated cross debt, General government

10-year long-term Interest rate on the government borrowing:

<https://www.ecb.europa.eu/home/html/index.en.html>
 Statistics > Monetary and financial statistics > Long-term interest rates, Euro-area, Long-term interest rates, the quarterly frequency

Tax revenues, direct taxes, indirect taxes and social contributions:

https://ec.europa.eu/taxation_customs/business/economic-analysis-taxation/data-taxation_en
 European Commission > Taxation and Customs Union > Business > Economic analysis of taxation > Data on taxation, the annual frequency

European commission Stability and Growth Pact:

European Commission > Economic and Financial Affairs > EU economic governance > Stability and Growth pact
http://ec.europa.eu/economy_finance/economic_governance/sgp/index_en.htm